

² Aircraft Owners and Pilots Association

Similarly, TDC³ did not believe that all devices above a certain minimum fractional bandwidth or upper bandwidth limit should be characterized as UWB, stating that most of the benefits of UWB come from having very few cycles within the pulse envelopes, not the duration of the pulse envelope itself”⁴

Additionally, the Commission discussed the possibility of certain types of UWB communications systems. In particular the Commission stated:

“We recognize that this may preclude certain types of modulations, such as swept frequency (e.g., FMCW), stepped frequency or frequency hopping systems. The current measurement procedures require that measurements of swept frequency devices be made with the frequency sweep stopped.”⁵

A number of companies failed to heed the Commissions comments in the R&O and are developing a system that the R&O specifically stated might be precluded. One motivation for the efforts may be found in a white paper published early on in the Multi-band UWB development.

“Finally, since the multi-bands technique is based on well known wireless communications scheme, modified for use with the UWB spectrum, the technology is not proprietary and the Intellectual Property is not owned by any individual company.”⁶

This statement, while somewhat motivating to companies evaluating the market, this was not then and is not now accurate.⁷ The below referenced patents clearly illustrate that founding members of the MBOA have filed core patents in this area, some prior to the release of this paper. Intellectual property issues aside, the development of these systems are not within the spirit of the rules.

To petition the Commission for a Waiver of the measurement rules is an admission that the devices currently under development will not be in compliance. For

³ Time Domain Corporation. Time Domain and its affiliated company Alerion are MBOA member companies.

⁴ First Report and Order Paragraph 28

⁵ “We also agree with ARRL and Delphi that various modulation types should be permitted **as long as the products comply with all of the technical standards** that are being adopted in this proceeding. Thus, as long as the transmission system complies with the fractional bandwidth or minimum bandwidth requirements at all times during its transmission, we agree that it should be permitted to operate under the UWB regulations.” Id at Paragraph 32

⁶ Comments of Dr. Roberto Aiello, CEO/CTO Staccato Communications,.

http://www.staccatocommunications.com/papers/New_Ultrawideband_Technology_Whitepaper.pdf

⁷ US Patent Applications 20040032354, 20040047285, <http://appft1.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fmetahtml%2FPTO%2Fsearch-bool.html&r=0&f=S&l=50&TERM1=uwb&FIELD1=&co1=AND&TERM2=%22sub+band%22&FIELD2=&d=PG01>

this technology to be viable will require additional power that is not within the current regulations.

I. The Petition is Prima Facie Improper.

- a. The veracity of the petitioners may be in question.

On page 3 of the petition, the statements regarding the development of the regulations with only pulsed based systems in mind appears to directly conflict with the with the comments of AARL, Delphi, and MBOA member Time Domain cited above. It is unlikely that the Commission received those comments, included them in the discussion, and ignored them in the rule making process.

- b. The petition may indicate that an improper ex-parte communications occurred.

On page 3 the Petition indicates “discussions” with the Commission that led the MBOA-SIG to believe that a Waiver Petition’s success would be dependent on the showing that there was no greater threat of harmful interference. The Ultra Wideband proceedings have been since their beginning “permit-but-disclose”. Permit-but-disclose proceedings allow for ex parte communications to occur but require the contents of these communications to be filed for public review. A review of the official record appears to be void of comments related to the standard by which a petition would be granted to a frequency hopping UWB system. If these ex parte communications have occurred, the MBOA-SIG may have failed to provide the required public filing for the rest of the UWB community to review.

- c. The Petition for Waiver does not represent the MBOA-SIG’s position.

The petition was filed on behalf of the MBOA-SIG but names Intel, Texas Instruments, Staccato Communications, Alerion, and Wisair as primary petitioners. According to their own press releases, the MBOA-SIG is an organization of over 160 member companies. A number of these companies, the commenter included, were never informed of the petition until after it was filed. Five of 160 companies is not even close to a quorum. The petition would not be in the best interest of a number of members of the SIG, there was no attempt within the SIG to gain consensus for a petition. For the petition to name as petitioner the MBOA-SIG is improper and the petition should be summarily dismissed.

II. The Commission’s Test Procedures Were Intended to and do Apply to MBOA Systems.

The waiver request for measurement of frequency hopping systems is based on the definition of “frequency hopping” systems. The primary focus of the argument is that based on Section 2.1 of the regulations, MB-OFDM is not a frequency hopping system. They support this assertion by claiming to be “sequenced” not a “long term distribution [that] appears to be random” as required by the definition. While a strict interpretation using this definition may imply that the Commissions measurement rules do not apply to

MB-OFDM systems, this argument is attenuated. FED-STD-1037C defines “frequency hopping” as:

“The repeated switching of frequencies during radio transmission according to a specified algorithm...”⁸

Furthermore, the use of this definition is **mandatory** by all federal departments and agencies.⁹ Since the pattern is admittedly “sequenced” it is done “according to a specified algorithm.” It is clearly within the scope of “frequency hopping”.

The Petition looks to paragraph 32 of the Report and Order to support the lack of intent on the part of the Commission. Specifically, it quotes the last sentence of the paragraph that states it is unlikely that frequency hopped systems would comply with the bandwidth requirement. This argument is misleading and entirely misses the point. The second sentence of paragraph 32 explicitly states the Commission’s intent. “We also agree with ARRL and Delphi that various modulation types should be permitted as long as the products comply with **all of the technical standards** that are being adopted in this proceeding.” All of the technical standards include the measurement techniques.

III. Granting the MBOA-SIG’s Request Would Give “Burst UWB” Devices an Unfair Advantage over “Pulsed UWB” Devices.

Multi-Band OFDM devices transmit “bursts” of 242.5 nanoseconds in duration. These types of system reach the required bandwidth by aggregating a number of narrowband carriers, and transmitting the resultant signal. In contrast, “pulse based” UWB devices achieve the required bandwidth from their narrow pulses.

The purported purpose of the PETITION FOR WAIVER is to “level the playing field” with pulsed based technology so that the market can decide which of these emerging technologies will best serve the public’s need.¹⁰ To grant a waiver would allow MBOA devices to transmit at power levels not allowed for non-MBOA devices. Currently, the transmit power is averaged over a millisecond in a one megahertz bandwidth. The MBOA devices transmit three “bursts” of energy within a microsecond window on three different hopped frequencies. In frequency hopping mode, the three bursts are sequenced through the three bands. Averaging across any one band the device is limited to –41.3 dBm/MHz. If this measurement is made with frequency hopping turned on the device may transmit at up to –35.4 dBm/MHz for the duration of each burst. A true “impulse radio” type of UWB system would still be limited to –41.3 dBm/MHz. A waiver request that results in increased power of one type of UWB device

⁸ Telecommunications: Glossary of Telecommunications Terms, Federal Standard 1037C

⁹ “Applicability. This standard incorporates and supersedes FED-STD-1037B, June 1991. Accordingly, all Federal departments and agencies shall use it as the authoritative source of definitions used in the preparation of all telecommunications documentation. The use of this standard by all Federal departments and agencies is **mandatory**. § 1.1, FED-STD-1037C

¹⁰ Petition For Waiver, Page 1

over another UWB device is unfounded. Additionally, the Petition asks to be tested under “normal” conditions. For there to be a difference in measured and “normal” operation indicates that this “normal” operation would not be compliant and will be precluded exactly as the Commission stated in the First Report and Order. Underlying this request is the desire to transmit at a higher power level in order to attain greater distances.

In the IEEE standards committee there are two competing technologies. A true-pulsed based system employing Direct Sequence Spread Spectrum technology (DS-UWB) is a current leading technology.¹¹ There are over 60 companies supporting this technology. The Commission has recently certified a chipset produced by one of these companies. In the past the MBOA was the leading proposal and over 100 companies support that technology. There are no working chipsets of this technology. The two systems cannot coexist with each other. They occupy the same frequency spectrum and are currently uncoordinated. Granting the waiver would allow the MBOA radio to more successfully jam the DS-UWB radio since it will be allowed an increase of power in band.

IV. Granting the MBOA-SIG’s Petition Would Cause an Increased Potential for Interference.

a. Interference to Other UWB Radios

While not normally within the scope of protection from interference, other types of UWB communications equipment will be negatively impacted by granting this waiver request.

The design described in the MBOA-SIGs waiver request transmits “bursts” of energy 242.5ns in duration then hops to a second band. These “bursts” are transmitted in the frequency bands from 3.168-3.696, 3.696-4.224, and 4.224-4.752 GHz. This device will transmit a significant amount of energy directly into the frequency bands used by other UWB communications equipment. Granting the waiver request will allow these devices to transmit at 4.8 dBm higher peak power. This additional power poses a significant risk to other UWB communications equipment.

b. Interference to Licensed Services

Aside from any concerns about the interference potential to other UWB devices due to increased power, uncoordinated dissimilar UWB communications devices may pose an increased risk of interference to licensed services. When the two types of UWB devices transmit in a co-interfering manner, there will be an increased number of retransmission requests by both types of devices. This in turn will cause an increase in the devices activity factor, which may impact other

¹¹ Oregon Meeting of the IEEE 802-15-3a, DSUWB was successful at eliminating MBOA but failed to reach confirmation.

spectrum users. This risk can be mitigated by coordination of UWB communications technologies.

c. The “test data” confirmation claimed by the MBOA is improper.

In the Petition the MBOA-SIG claim to have conducted their own tests and shown the devices actually pose a lower risk of interference.¹² These “tests” were never validated by an objective 3rd party nor made available to the public, nor even the membership of the MBOA.

V. A Waiver is Inconsistent with the Telecommunications Act of 1996.

Section 706 of the Telecommunications Act of 1996 requires the Commission to “encourage the deployment on a reasonable and timely basis advanced telecommunications capability to all Americans.”¹³ Additionally, the act defines “advanced telecommunications capability without regard to any specific technology.”¹⁴ To grant a waiver to one type of UWB communications devices that would in turn increase the risk of harmful interference to another type of UWB is placing, not removing a barrier to that technology. Regulatory forbearance, as delineated under 706(a) is the wiser course of action.

VI. Cognitive Techniques in UWB

. Cognitive Radio Technology (CRT) is defined as technologies that:

“[M]ake possible more intensive and efficient spectrum use by licensees within their own networks, and by spectrum users sharing spectrum access on a negotiated or an opportunistic basis. These technologies include, among other things, the ability of devices to determine their location, sense spectrum use by neighboring devices, change frequency, adjust output power, and even alter transmission parameters and characteristics.”¹⁵

A CRT enabled UWB device will listen to other CRT enabled UWB devices within its geographical region and coordinate, or negotiate its transmission with those devices. CRT should be promoted in UWB.

A number of CRTs are available for implementation in UWB devices. A minimum set of CRT functionality should include:

a. CRT UWB devices should be able to transmit a periodic universal beacon.

¹² Page 8 of the Petition

¹³ Telecommunications Act of 1996 Section 706.

¹⁴ Id.

¹⁵ ET Docket No. 03-108, Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies”, Federal Communications Commission, December 17, 2003.

In the other unlicensed dockets a requirement for unlicensed devices transmitting a device identification signal has been proposed.¹⁶ Additionally, employing a listen before talk mechanism has been promoted in a number of proceedings.¹⁷ Specifically, in the 3.65-3.7 GHz frequency range it has been suggested that all devices listen for a beacon located at 3.65-3.651 GHz.

- b. A CRT UWB device should coordinate spectrum use with other CRT enabled devices.

A multiple access technology, such as TDMA, could be used across all types of high data rate UWB devices. Dissimilar physical layer technologies can implement enough common functionality to coordinate spectrum use. In a TDMA manner it could be interleaving high data rate frames with low data rate universal frames to provide for coordination in spectrum access.

The use of CRT within UWB radios will mitigate cross interference between types of UWB devices. Additionally, since CRT is used to provide coordination between dissimilar UWB devices, it mitigates the increased activity factor described above and therefore any potential for interference caused by aggregation.

VII. The Commission should Increase the Power Limits by 6dBm for all CRT enabled UWB Communications Devices.

- a. Cognitive UWB Radios Should be Able to Transmit at Higher Power

In the Cognitive Radio Docket, there is a proposal to increase the transmission power for any radio technology using Cognitive Technologies. Specifically, the NPRM proposes to allow Cognitive Radios in the 902-928 MHz, 2.4-2.4835 GHz, and the 5.725-5.850 GHz bands to transmit at 8dB higher power levels than non-cognitive radios in those bands.¹⁸ As long as the increased power does not cause interference, Cognitive UWB radios employing a CSM should be given the same power increases.

- b. Singapore studies show UWB transmission at 6dB higher levels does not cause harmful interference to licensed services.

In 2003 the Infocomm Development Authority of Singapore (IDA) launched a program designed to bring UWB to Singapore. In this program the IDA established a geographical UWB Friendly Zone (UFZ). In this zone UWB device

¹⁶ , Notice of Proposed Rule Making, In the Matter of Unlicensed Operation in the Band 3650-3700, FCC 04-151, paragraph 38, Adopted 04/15/2004.

¹⁷ Id, See also Cognitive Radio Docket.

¹⁸ In the Matter of: Facilitation Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, ET Docket No. 03-108m Paragraphs 38 and 39

developers were given wide latitude in experimenting with UWB devices.¹⁹ As shown in Figure 1, the Singapore mask allows UWB transmission at -35.3 dBm versus the current FCC allowance of -41.3 dBm. It is additionally important to note that the allowed frequency range begins at 2.2 GHz instead of the 3.1 GHz here in the US.

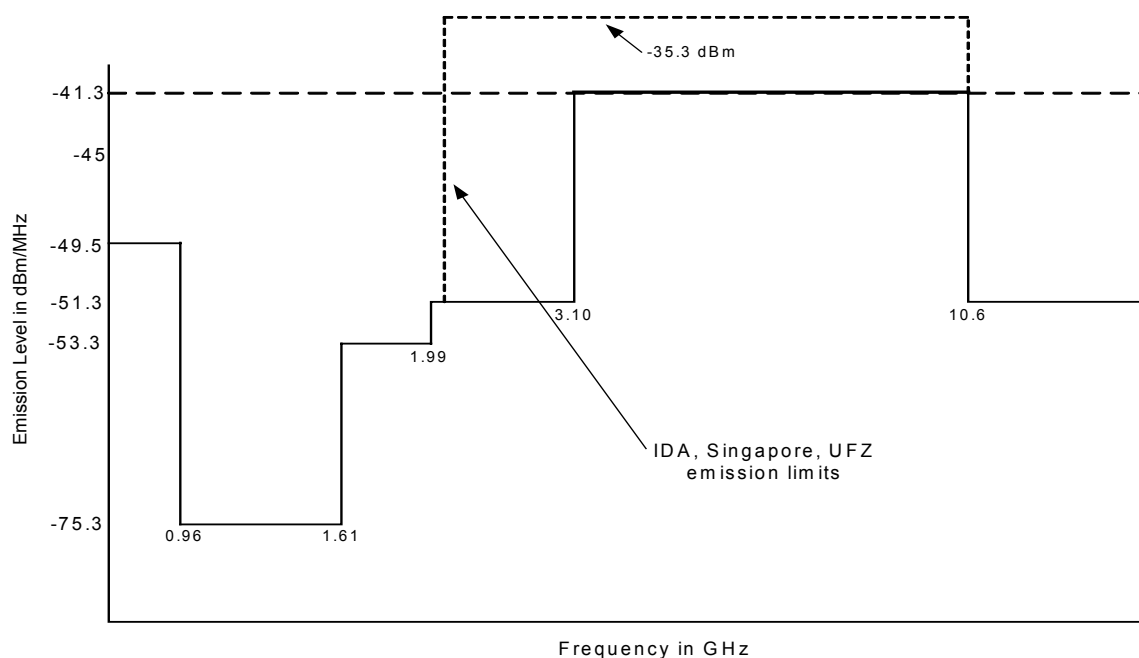


FIGURE 1 The Singapore UFZ emission limits compared with the FCC handheld limits.²⁰

At the International Telecommunications Union Task Group 1/8 meeting in Boston in June of 2004, the IDA presented some results of their studies. They stated:

“Our field test results indicate that, in practice, a UWB transmitter in the vicinity of a handset is unlikely to have any measurable impact on the handset’s performance when the handset is close to the base station. At the boundary of the coverage cell, there may be instances where some degradation in the handset’s performance may be experienced when the UWB transmitter is within 0.3 m of the victim handset, even when the transmitter conforms to the FCC Part 15 Subpart F emission limits for handheld UWB devices (-63 dBm/MHz). However, considering that the average RxQual was lower than 3 in all of our test cases, the impact is not expected to be severe. When the UWB transmitter is farther than 0.5 m from the handset, the handset experiences virtually no measurable performance degradation.

¹⁹ Ultra-Wideband Radio Technology, Kazimierz Siwiak, Debra McKeown, John Wiley & Sons, Ltd. 2004, Page 33.

²⁰ Id. At 34, Reproduced with Permission

A further observation made during the DCS1800 field tests is that, under certain operating conditions, the performance of a DCS1800 handset is more likely to be limited by adjacent channel interference, or sometimes even co-channel interference from another cell because of frequency reuse, rather than by the presence of a UWB device in its immediate vicinity.”²¹

“[I]t should also be noted that our field test with a local satellite operator failed to produce any evidence that, under reasonable usage conditions, an FCC-compliant UWB device (short-pulse or MB-OFDM) transmitting in the vicinity of a satellite dish would result in any measurable amount of interference.”²²

c. The Commission should raise the power limits of all CRT enabled UWB communications Devices.

In the First Report and Order the power limits were intentionally set to be conservative.²³ This was an important step for the Commission to take since UWB technology represents a fundamental change in how frequency is used. Commissioner Martin stated “I look forward to re-examining the technical parameters established in this order once we have more data that will address the interference concerns expressed by NTIA”²⁴

In the Memorandum Opinion and Order and Further Notice of Proposed Rule Making, the Commission declined to make significant technical changes until “we have more experience with UWB devices.”²⁵ In this order the Commission sought additional tests using commercial UWB devices, and stated their intent to revisit the rules in 12-18 months.²⁶

Nineteen months have passed since the Memorandum and Order, real UWB devices have been tested in Singapore showing no interference at power levels 6 dB higher and 900 MHz lower in emission. As originally acknowledged by the Commission, the UWB limitations were set conservatively. Cognitive Radio Technology techniques such as “Listen Before Talk” or Clear Channel Assessment insure that UWB devices so enabled

²¹ Ultra-wideband (UWB) COMPATIBILITY STUDIES WITH DCS1800/GPRS (1 800 MHZ) SYSTEMS, Infocomm Development Authority of Singapore (IDA), Document 1-8/94-E, June 01, 2004, <http://www.itu.int/md/meetingdoc.asp?lang=e&type=sfolders&parent=R03-TG1.8-C&PageLB=50>

²² IMPACT of Ultra-Wideband (UWB) INTERFERENCE on A C-band Fixed satellite service (FSS) RECEIVER, , Infocomm Development Authority of Singapore (IDA), Document 1-8/95-E, June 01, 2004, <http://www.itu.int/md/meetingdoc.asp?lang=e&type=sfolders&parent=R03-TG1.8-C&PageLB=50>

²³ SEPARATE STATEMENT OF COMMISSIONER MICHAEL J. COPPS, First Report and Order, In the Matter of the Revision of Part 15 Commission’s Rules Regarding Ultra-Wideband Transmission Systems.

²⁴ SEPARATE STATEMENT OF COMMISSIONER KEVIN J. MARTIN, First Report and Order, In the Matter of the Revision of Part 15 Commission’s Rules Regarding Ultra-Wideband Transmission Systems.

²⁵ MO&O, Issued February 13, 2003 Paragraph 1

²⁶ Id.

will not introduce interference to other spectrum users. The power limit should be raised on all CRT enabled UWB communications devices. It is time to raise the power limits.

VIII. The Impact of a Waiver or Modification to the Rules on Small Businesses.

Any change to the rules requires an analysis of its impact on small businesses.²⁷ The Regulatory Flexibility Act (RFA) defines “small entity” as having the same meaning as the terms “small business”, “small organization”, and “small business concern”.²⁸

a. Granting a Waiver Petition is not in the Best Interest of Small Business.

As discussed above, granting the Waiver Petition would be detrimental to non-MBOA UWB devices. As shown in Figure 2, most of the companies within the MBOA are large entities. The member list of the opposing SIG, UWB-Forum, reads like a “who’s who” of small entities and startup companies. To allow devices from large entities, like the MBOA member companies, to transmit at a higher power level than devices made by small entities, places those small companies at a significant disadvantage in the marketplace. The UWB technologies developed by these Small Businesses were developed with strict adherence to FCC regulations. Giving large entities the advantage of higher power emission limits will put the smaller entities at a competitive disadvantage. The use of Cognitive Radio Technologies to increase power emissions by 6 dB will allow both large and small businesses to benefit as well as consumers.

²⁷ Regulatory Flexibility Act of 1980.

²⁸ Id. at 601(3)

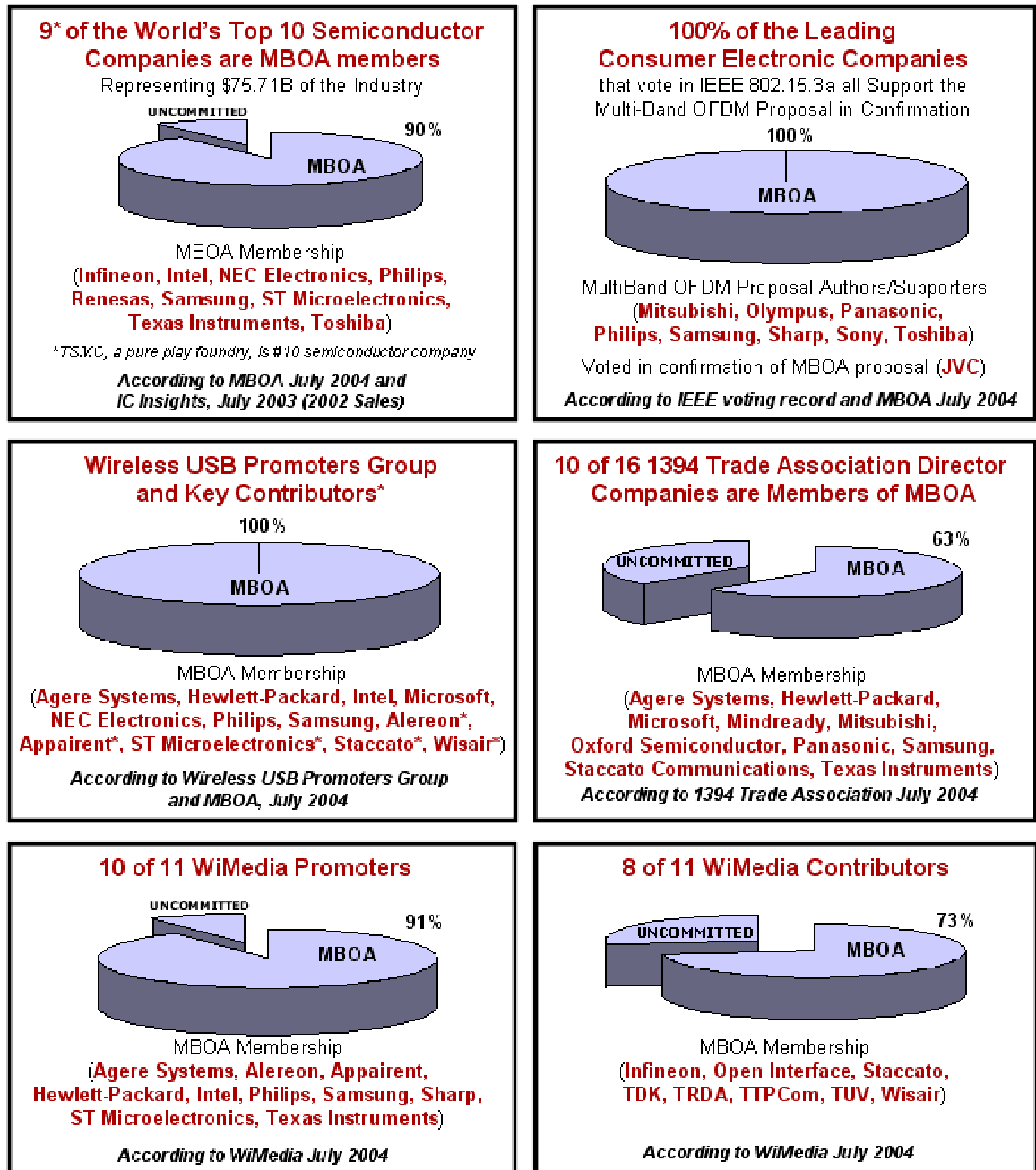


Figure 2. MBOA membership and support chart.²⁹

- b. Increased Power for UWB Devices employing Cognitive Radio Technologies is in the Best Interest of Small Business.

As discussed below, the implementation of a CRT in UWB devices is not a major engineering change for any current UWB company. Additionally, the only company that has working, FCC certified, UWB chipsets, is a member of the SIG that supports CRTs in

²⁹ http://www.multibandofdm.org/commercial_support.html

UWB devices. With most other companies still in development of their designs, the changes are minor to implement. CRT would greatly benefit consumers, and UWB chip suppliers alike.

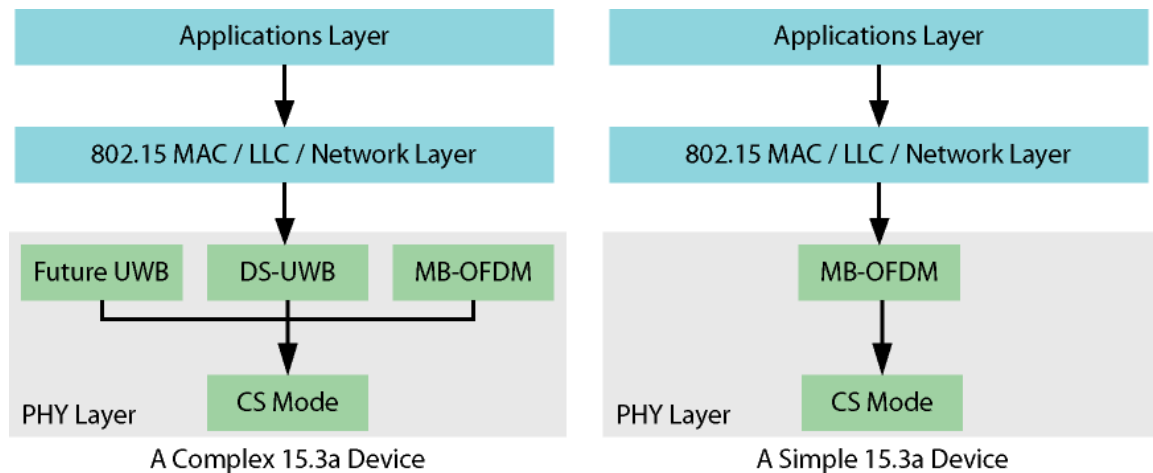


FIGURE 3. CRT WITH SIMPLE DEVICES (IMPLEMENT ONE HDR UWB PHY), AND COMPLEX DEVICES (IMPLEMENT MULTIPLE UWB PHY LAYERS).

Conclusion.

A 6dB increase in the transmission power of all CRT enabled UWB devices should render the Petition moot. The primary goal of asking for the waiver of the frequency hopping measurement techniques is to allow MBOA-SIG devices to operate at approximately 5.9 dBm/MHz higher than the current limit. The increased power level is crucial to make this form of UWB commercially viable. The rest of the industry should not be penalized for the MBOA-SIGs expenditures in designing devices that do not comply with the current regulation. The MBOA devices are being designed in the face of the Commissions warning that these types of devices would likely be precluded by the rules.³⁰

An increase in the transmission power for all CRT enabled UWB devices is keeping with the Commissions goals of promoting more efficient use of spectrum by employing Cognitive Radio technologies. It is in the best interest of the public since it will allow CRT enabled UWB devices to become more functional, provide more services to consumers, and achieve greater transmission distances and potentially higher data rates. An increase in transmission power will remove a regulatory hurdle in bringing an advanced telecommunications technology to all Americans.

³⁰ First Report and Order Paragraphs 35 and 36.